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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/627,838      | 07/25/2003  | Grant Kloster        | 42P14682            | 3722             |

7590 01/26/2006

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EXAMINER

CHEN, ERIC BRICE

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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1765

DATE MAILED: 01/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/627,838

Applicant(s)

KLOSTER ET AL.

Examiner

Eric B. Chen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 09 December 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,5,9 and 11-34 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1,2,5,9 and 25-34 is/are allowed.
- 6) ☒ Claim(s) 11-17 and 21-24 is/are rejected.
- 7) ☒ Claim(s) 18-20 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Specification*

1. The use of the trademarks LKD-5109, JSR, NANOGLOSS-E, HONEYWELL, ZIRKON, SHIPLEY, SILK, DOW CHEMICAL, and GX-3P has been noted in this application (Applicants' Specification, filed Jul. 25, 2003, page 5, paragraph 0020). It should be capitalized wherever it appears and be accompanied by the generic terminology. Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 11-13 and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by RamachandraRao (U.S. Patent Appl. Pub. No. 2004/0072436).

4. The applied reference has a common assignee with the instant application.

Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art

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under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

5. As to claim 11, RamachandraRao discloses a method comprising: etching a via and a trench in a dielectric (paragraph 0044; Figure 7), wherein the dielectric (302) has a plurality of pores (paragraphs 0029, 0036); exposing the dielectric to an oxidant to prepare the surface of the dielectric (302) (paragraphs 0035); treating the surface of the dielectric with a silane coupling reagent after exposing the dielectric (302) to the oxidant (paragraph 0035, "[d]uring... plasma etches... the plasma oxidizes...", "[w]hat remains is an SiO<sub>2</sub>-type surface") to seal the pores exposed on the surface of the dielectric (paragraph 0037); and forming a conductive layer (1002) on the surface of the dielectric (paragraph 0049; Figure 10).

6. As to claim 12, RamachandraRao discloses that the dielectric is an oxide (paragraph 0032).

7. As to claim 13, RamachandraRao discloses that the silane coupling reagent comprises an alkoxysilane (paragraph 0037).

8. As to claim 15, RamachandraRao discloses that the dielectric is a polymer (paragraph 0035).

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***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Catabay et al. (U.S. Patent No. 6,537,896).

11. As to claim 11, Catabay discloses a method comprising: etching a via and a trench (40) in a dielectric (20), wherein the dielectric has a plurality of pores (22) (column 7, lines 10-15; Figure 5); exposing the dielectric to an oxidant to prepare the surface of the dielectric (150) (column 5, lines 32-38); treating the surface of the dielectric with a silane coupling reagent (column 5, lines 32-38) to seal the pores exposed on the surface of the dielectric (150) (column 7, lines 17-19); and forming a conductive layer on the surface of the dielectric (column 7, lines 19-26).

12. Catabay does not expressly disclose treating the surface with silane after exposing the dielectric to the oxidant. Catabay discloses the simultaneously treating the surface with silane and exposing the dielectric to an oxidant (column 5, lines 32-38). However, case law has held that the transposition of two steps or the splitting of one step into two, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin*, 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Thus, the treating the surface with silane after exposing the dielectric to the oxidant, instead of simultaneous

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treatment, is the splitting of one step into two. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to treat the surface with silane after exposing the dielectric to the oxidant.

13. As to claim 12, Catabay discloses that the dielectric is an oxide (column 3, lines 26-29).

***Claim Rejections - 35 USC § 102***

14. Claims 13 and 15-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Catabay, in view of Komatsu (U.S. Patent No. 6,451,436).

15. As to claim 13, Catabay does not expressly disclose that the silane coupling reagent comprises an alkoxysilane. However, Komatsu discloses a method for forming a silicon-containing film with a low dielectric constant as low as 3 with excellent substrate adhesion and film strength (column 2, lines 56-60), using an alkoxysilane composition (column 4, lines 6-23). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a silane coupling reagent comprises an alkoxysilane. One who is skilled in the art would be motivated to use alkoxysilane to fill the pores with a silicon-containing material with a low dielectric constant with excellent adhesion and strength.

16. As to claim 15, Catabay does not expressly disclose that the dielectric is a polymer. However, Komatsu teaches that polymer dielectrics have a lower dielectric constant of less than 3 (column 1, lines 51-58) to lower the overall capacitance of the electrical interconnect (column 2, lines 7-9). Therefore, it would have been obvious to

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one of ordinary skill in the art at the time the invention was made to use a polymer dielectric. One who is skilled in the art would be motivated to use a material with a lower dielectric constant, to lower the overall capacitance of the interconnect structure.

17. As to claim 16, Catabay does not expressly disclose that the silane coupling reagent comprises an alkoxyvinylsilane. However, Komatsu discloses a method for forming a silicon-containing film with a low dielectric constant as low as 3 with excellent substrate adhesion and film strength (column 2, lines 56-60), using an alkoxyvinylsilane composition (column 4, lines 6-23). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a silane coupling reagent comprises an alkoxyvinylsilane. One who is skilled in the art would be motivated to use alkoxyvinylsilane to fill the pores with a silicon-containing material with a low dielectric constant with excellent adhesion and strength.

18. As to claim 17, Komatsu discloses that the alkoxyvinylsilane is vinyltriethoxysilane (column 4, lines 29-30).

### ***Claim Rejections - 35 USC § 103***

19. Claims 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Catabay, in view of Yau et al. (U.S. Patent No. 6,054,379).

20. As to claim 21, Catabay does not expressly disclose that treating comprises bubble vapor deposition of the silane coupling reagent. Yau discloses a method of forming a barrier layer for porous low k dielectric layers with a silane based compound (column 2, lines 46-54). Moreover, Yau teaches delivering the silane based process

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gas through vaporization from a liquid precursor and an adding an inert delivery gas (column 9, lines 2-12). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to treat by bubble vapor deposition of the silane coupling reagent. One who is skilled in the art would be motivated to use bubble vapor deposition, because this method has been used successfully in forming a barrier layer for a porous low k dielectric.

21. As to claim 22, Yau discloses that the bubble-vapor deposition carrier gas comprises Nitrogen ( $N_2$ ) (column 8, lines 62-63; column 10, lines 61-62).

22. As to claim 23, Yau discloses that the bubble-vapor deposition carrier gas comprises Argon (column 8, lines 62-63; column 10, lines 61-62).

23. As to claim 24, Catabay does not expressly disclose that treating comprises spin-coating the silane coupling reagent onto the dielectric. Yau discloses a method of forming a barrier layer for porous low k dielectric layers with a silane based compound (column 2, lines 46-54). Moreover, Yau teaches depositing the barrier layer by spin coating silane the based compound, a technique which is self-planarizing (column 10, lines 31-35). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to spin-coating the silane coupling reagent onto the dielectric. One who is skilled in the art would be motivated to spin coat, because this method has been used successfully in forming a self-planarizing barrier layer for a porous low k dielectric.



***Claim Rejections - 35 USC § 103***

24. Claims 14 and is rejected under 35 U.S.C. 103(a) as being unpatentable over Catabay, in view of Komatsu, in further view of Kloster et al. (U.S. Patent Appl. Pub. No. 2004/0214427).

25. As to claim 14, Catabay does not expressly disclose that the alkoxysilane is methoxypropyltrimethoxysilane. Komatsu discloses a method for forming a silicon-containing film with a low dielectric constant as low as 3 with excellent substrate adhesion and film strength (column 2, lines 56-60), using an alkoxysilane composition (column 4, lines 6-23). Kloster teaches the use of methoxypropyltrimethoxysilane as a pore filling agent for porous dielectrics (paragraph 0033). Moreover, Kloster teaches that methoxypropyltrimethoxysilane is effective at sealing pores (paragraph 0033) by effectively attaching to the sidewalls within the pores (paragraph 0030). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use methoxypropyltrimethoxysilane. One who is skilled in the art would be motivated to use an alkoxysilane composition that effectively fills pores.

***Allowable Subject Matter***

26. Claims 1, 2, 5, and 9 are allowed.

27. The following is a statement of reasons for the indication of allowable subject matter for claim 1: the prior art fails to teach or suggest exposing the dielectric to a silane coupling reagent comprising an *oligomer of an alkoxysilane*. The closest prior art, Hacker, discloses exposing the dielectric to various surface modifications

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compositions (paragraph 0033). However, there is no motivation or suggestion of an oligomer of an alkoxysilane, as in the context of claim 1.

28. Claims 18-20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

29. The following is a statement of reasons for the indication of allowable subject matter for claim 18: the prior art fails to teach or suggest that the silane coupling reagent comprises an *oligomeric structure*, as discussed above.

30. Claims 25-34 are allowed.

31. The following is an examiner's statement of reasons for allowance for claim 25: the prior art fails to teach or suggest that the silane coupling reagent comprising an *oligomeric structure*, as discussed above.

32. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Response to Arguments***

33. The objection to claim 14 has been withdrawn in view of Applicants' amendments to the claims (page 3), filed Dec. 9, 2005.

34. Applicants' arguments (Applicants' Remarks, page 8), filed Dec. 9, 2005, with respect to the provisional rejection of claims 1-6, 10-13, 15-18, 25-28, and 32 under the

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judicially created doctrine of obviousness-type double patenting over RamachandraRoa have been fully considered and are persuasive. In view of Applicants' amendments to the claims, the Applicants' claims and RamachandraRoa's claims are no longer conflicting. The provisional rejection of claims 1-6, 10-13, 15-18, 25-28, and 32 has been withdrawn.

35. Applicants' arguments (Applicants' Remarks, page 9), filed Dec. 9, 2005, regarding the rejection of claims 1, 2, 5, and 9 under 35 U.S.C. 102(e) as being anticipated by RamachandraRoa have fully considered and are persuasive. Applicants have pointed out that the RamachandraRoa reference does not teach or suggest "a silane coupling reagent comprising an oligomer of an alkoxysilane" (page 9). The rejection of claims 1, 2, 5, and 9 has been withdrawn.

36. Applicants' arguments (Applicants' Remarks, page 9), filed Dec. 9, 2005, regarding the rejection of claims 11-13 and 15 under 35 U.S.C. 102(e) as being anticipated by RamachandraRoa have fully considered, but they are not are persuasive. The RamachandraRoa reference teaches the newly added claim limitations of "exposing the dielectric to an oxidant to prepare the surface of the dielectric" and "treating the surface of the dielectric with a silane coupling reagent after exposing the dielectric to the oxidant to seal the pores exposed on the surface of the dielectric."

37. Applicants' arguments (Applicants' Remarks, page 9), filed Dec. 9, 2005, regarding the rejection of claims 25-34 under 35 U.S.C. 102(e) as being anticipated by RamachandraRoa have fully considered and are persuasive. Applicants have pointed out that the RamachandraRoa reference does not teach or suggest "the silane coupling

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reagent comprising an oligomeric structure" (page 9). The rejection of claims 25-34 has been withdrawn.

38. Applicants' arguments (Applicants' Remarks, page 10), filed Dec. 9, 2005, regarding the rejection of claim 1 under 35 U.S.C. 103(a) as unpatentable over Catabay, in view of Hacker, have fully considered and are persuasive. Applicants have pointed out that the Catabay and Hacker references does not teach or suggest "a silane coupling reagent comprising an oligomer of an alkoxysilane" (page 10). The rejection of claims 1, 2, 5, and 9 has been withdrawn.

39. Applicants' arguments (Applicants' Remarks, page 9), filed Dec. 9, 2005, regarding the rejection of claim 11 under 35 U.S.C. 102(e) as anticipated by Catabay have fully considered and are persuasive. However, the newly added claim limitations of "exposing the dielectric to an oxidant to prepare the surface of the dielectric" and "treating the surface of the dielectric with a silane coupling reagent after exposing the dielectric to the oxidant to seal the pores exposed on the surface of the dielectric" are suggested by the Catabay reference.

40. Applicants' arguments (Applicants' Remarks, page 9), filed Dec. 9, 2005, regarding the rejection of claim 25 under 35 U.S.C. 103(a) as being unpatentable over Catabay have fully considered and are persuasive. Applicants have pointed out that the Catabay reference does not teach or suggest "the silane coupling reagent comprising an oligomeric structure" (page 9). The rejection of claims 25-34 has been withdrawn.

***Conclusion***

41. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EBC

Jan. 9, 2006



NADINE G. NORTON  
SUPERVISORY PATENT EXAMINER

